

Abstract

A low-Cost Mission to 2060 Chiron Based on the Pluto Fast Flyby

S. A. Stern**, C. G. Salvo*, R. A. Wallace*, S. S. Weinstein*, & P. R. Weissman*

The Pluto Fast Flyby-based mission to Chiron described in this paper is a low cost, scientifically rewarding, focused mission in the outer solar system. The proposed mission will make a flyby of 2060 Chiron, an active "comet" with over 104 times the mass of Halley, and an eccentric, Saturn-crossing orbit which ranges from 8.5 to 19 AU. The mission concept achieves the flyby 4.2 years after launch on a direct trajectory from Earth, is independent of Jupiter launch windows, and fits within Discovery cost guidelines. This mission offers the scientific opportunity to examine a class of object left unsampled by the trail-blazing Mariners, Pioneers, Voyagers, and missions to Halley.

Spacecraft reconnaissance of Chiron addresses unique objectives relating to cometary science, other small bodies, the structure of quasi-bound atmospheres on modest-sized bodies, and the origin of primitive bodies and the giant planets. Owing to Chiron's large size ($180 < D < 370$ km), unique nature, and unusual orbit, this mission is likely to draw significant public interest. As described by COMPLEX, the SSEC, and later the SSES, flybys are the appropriate scale missions for initial reconnaissance missions.

Carrying 3 sophisticated instruments, the proposed flyby will return critical data about Chiron's size, shape, polar obliquity, atmosphere, surface morphology, surface composition, internal structure, surface activity (including the nature of Chiron's outbursts), and origin. Engineering analysis indicates that the spacecraft is capable of navigating to and encountering Chiron at close approach distances of < 5000 km, well inside the 50,000-150,000 km coma, and perhaps within the collisional chemistry zone of the coma.

The low cost of the proposed Chiron mission is based on the opportunity to use the planned Pluto Flyby spare spacecraft and a Proton Expendable Launch Vehicle (ELV) (the Pluto spacecraft is being designed to be compatible with a Proton launch). Backup launch opportunities on Delta II and Atlas ELVs are available.

The Pluto Fast Flyby mission plans to develop a low-cost (\$ 150 M), lightweight (< 150 kg) outer planet spacecraft which is well-suited to flyby reconnaissance in the outer solar system. This Chiron flyby mission is designed to leverage SSEC's Pluto spacecraft investment into a scientifically valuable successor mission within the Discovery cost cap.

Taking advantage of the spare Pluto spacecraft, we estimate the Discovery Chiron intercept mission can be launched for $< \$100$ M. We believe this makes a highly attractive proposal, which maintains US presence and leadership in the study of the outer solar system, and enables the first-time exploration of a wholly new class of planetary target, an outer solar system planetesimal. Reference Chiron Flyby science payload instruments are listed below.

	<u>Imager</u>	<u>Gas Chromatography</u>	<u>Mass Spectrometer</u>
Mass	5.1 kg	7.4 kg	5.0 kg
Power	7.0 w	7.5 w	14.0 w
Data rate	3Mbit/Img ¹	7 Kbps	1 Kbps
Location	S/C bus	S/C bus	S/C bus
Pointing accuracy	2.0 mrad	1.0 deg	1.0 deg
Heritage	Pluto Flyby	Giotto	PVenus, CRAF
Cost (\$M)	13.5	7.5 ²	5.0

¹ After 3:1 Compression; ² GCMA could be ESA-donated.

** Southwest Research Institute, San Antonio, TX; * Jet Propulsion Laboratory, Pasadena, CA